NASA - Langley

NASA-OART FIELD INSPECTION

LOW-SPEED RESEARCH

Low-speed research is still important. In fact, work in this area is even more important and the problems we face are greater than in the past for two reasons. First, we are working with the low-speed characteristics of very high-speed vehicles - aircraft and spacecraft - that have to come back and land at low speeds. Their shapes, however, are being dictated by the requirements for high-speed flight. We are having to learn how to live with these shapes and how to modify them the little bit we can to make them reasonably safe to land. The second reason we are particularly interested in low-speed research is that in the past few years we have been working on a class of aircraft that fly at speeds much lower than those of conventional aircraft. These are such things as helicopters, V/STOL aircraft, and parawings, and they have introduced brand new problems in the ultra-low-speed range.

Although the problems might be new, we are fortunate in being able to use most of the facilities and techniques that have been built up over the years. In fact, one advantage we have at Langley for doing this work is that we have an established set of coordinated facilities. Not only a well-coordinated set of low-speed research facilities but also coordinated at the same laboratory with the people that are doing the high-speed research so that we can readily have the give and take required to work out the configurations suitable for both ends of the speed range.

The low-speed techniques we have range all the way from flight tests, through large and small scale wind-tunnel force tests and several different flying model test techniques, to theoretical analysis. We will show how we use these facilities and how the different techniques are blended to take an idea from the first conceptual idea on through specific support for operational aircraft or spacecraft. We will do this with two main examples. One is the V/STOL area and the other is the spacecraft landing area. In the V/STOL area, the development of the tilt-wing transport concept will be shown from our first flying model through various intermediate steps of small and large scale force tests, improved flying models, the extensive VZ-2 test bed support, to support of the XC-142A Tri-Service Transport program. This will be shown using charts, models, the VZ-2 test bed aircraft, and movies. In the spacecraft landing area, the parawing capsule recovery system will be illustrated with models and a movie of deployment tests. The lifting body concept will be illustrated with a number of flying models of various shapes on display and with the full-scale HL-10 model which will be mounted in the full-scale tunnel test section during May. The story here will be to show the exploratory work with generalized shapes in the beginning then support of the more promising shapes, the M-2 and the HL-10, with flying models, large and small scale force test models, and manned gliders at Edwards.

(Typed 3/19/64, bsp)

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NASA-OART FIELD INSPECTION

AERONAUTICS

I. Presentation on Evolution of Supersonic Flight

A. Charts on velocity-range spectrum of research and operational aircraft, drag element comparison of subsonic and supersonic aircraft.

B. Models of SCAT 15F and advanced SCAT 16.

C. A live wind-tunnel demonstration in UPWT Test Section No. 2 will be made to illustrate favorable interference by varying nacelle location under wing-body model. The nacelle force and wing-body force variation will be demonstrated by indicating balances. A color Schlieren system will depict the interference flow fields.

II. Presentation on Multimission Capability of Aircraft

A. Charts on history of maximum/minimum speed capability of aircraft, typical SCAT multimission profile and multimission profile of current military aircraft (F-111).

B. Tactical mission display.- The idea of this display is to provide visitors with accurate feel of such a mission by viewing from rear a model having movable and programed flap deflection and wing-sweep angle while projecting authentic flight cockpit sequences of simulated mission on screen into which model appears to be flying.

C. Variable-sweep models of TAC-8A, CAP II, etc.

III. Miscellaneous Props

A. Set of existing twisted and cambered wing-body models.

B. Jet-exit research display.

C. SCAT 4, 15, 16, and 17 feasibility study models.

(Typed 3/20/64, bsp)

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NASA-OART FIELD INSPECTION

SPACE FLIGHT SIMULATION

This presentation will be an introduction of spacecraft simulation research at the Langley Research Center. The presentation will be based on the following subjects:

1. Lola.- A brief description will be given of the lunar orbit and letdown approach mission, and how the simulator operates. Depending on whether the audience has been to Building 1220 or not, this description will be correlated to what they have seen or will see and hear at 1220.

2. Abort study in SMD planetarium.- A brief description will be given of the work done. The accompanying poster will be clarified during this description.

3. Outdoor Lunar Landing Facility.- It will be shown that this facility will study that part of lunar descent if an abort is not necessary. The description of the Lunar Landing Facility will be coordinated with the drive-by at the Lunar Landing Facility site. Models of the gantry and landing bug will be used to clarify the simulator's description. Purpose and philosophy of the simulation will be briefly described also.

4. Lunar Walker Simulator.- The walker will be described, both the Hangar walker and the 200-foot simulator at the Lunar Landing Facility. The manner of obtaining one-sixth gravity will be described. This description also will be coordinated with what the group hears and sees during their drive-by at the Lunar Landing Facility site.

5. A brief sound film of the lunar walker will then be shown. It will be pointed out that this is the Hangar model.

6. Discussion of lunar ascent will be started by describing the philosophy of lunar take-off. A poster will be used to show a "stepping method" of take-off and climb. The animated Lunar Ascent Panel will be put in motion during this description.

7. As the animation takes place, a description will be made of studies conducted on the Visual Docking Simulator and Rendezvous Docking Simulator (VDS and RDS). It will be pointed out how these studies support the Apollo-LEM rendezvous docking problem and the purpose they served in the Gemini Project. Posters of these simulators will be shown. Also, remarks will be made on the rendezvous study set up in the balloon. Its purpose in the Gemini and Apollo-LEM Projects will be clarified and a brief description of its operation will be made.

8. The group will then be allowed to leave their seats, take a quick view of the rendezvous simulator within the balloon, and then regroup to watch the RDS perform dynamic docking of the Apollo and LEM.

This presentation will tell a story of the LOR mission from lunar descent of LEM to docking of Apollo-LEM after lunar ascent. It will describe how each simulation fits into and supports the program. Also, it will be presented in such a way that the audience has a feeling for the individual simulations and will be correlated with presentations at 1220 and Lunar Landing Facility site.

(Typed 3/20/64, bsp)

NASA - Langley

NASA-OART FIELD INSPECTION

ELECTRONIC COMPUTERS IN AEROSPACE RESEARCH

The purpose of the presentation is to discuss, and to illustrate by demonstrations, the vital role of computing and data-handling equipment in the conduct of NASA's research programs. The outline for the presentation is shown below:

I. Introduction

II. Administrative versus Research Computing Equipment Applications in NASA

III. Discussion of Research Applications in NASA

A. Theoretical Research
B. Engineering Studies
C. Experimental Research
D. Simulation
E. Command and Control
F. Evaluation

IV. Discussion of LRC Use of Computing and Data-Handling Equipment

V. Active Demonstrations of selected applications

VI. Conclusions

Planned demonstrations will illustrate the use of electronic computing and data-handling equipment for conducting engineering studies and experimental data reduction.

A. Engineering Studies

The 4554 Display Console will be used with the 7094 computer to show how computers are used in the development of space flight missions and how they may be used to determine the feasibility of various approaches and to optimize the selected approach.

B. Experimental Data Reduction

Telemetered data recorded during the flight of a vehicle from Wallops Station will be played back, digitized and written on a digital magnetic tape for the computer. The results of the subsequent computations will be presented on a high-speed display recorder to show the transformations needed for the post-flight analysis. A comparison of the form of the information as received at the telemeter receiving station with the computer results will vividly show the value of the automatic equipment in this work.

(Typed 3/20/64, bsp)

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NASA-OART FIELD INSPECTION

LAUNCH VEHICLE AND SPACECRAFT DYNAMICS

The presentation will begin with a 12-minute discussion of research conducted by the Dynamic Loads Division in the area of launch vehicle and spacecraft dynamics. The individual topics to be covered include:

Ground Wind Loads

Engine Ignition Shocks
- Vibration
- Launch Site Noise

Control During Ascent
- Gusts and Wind Shear Loads
- Fuel Slosh

Buffeting and Aerodynamic Noise
- Panel Response
- Payload Vibration

Pogo Oscillations

Dome Impact Fuel Sloshing

The discussion will be supplemented with visual aids. An animated wall chart relating the problem area to the vehicle trajectory (time) will be the focal presentation. As the speaker is talking about a particular phase of research, a model of a missile will light up on the wall chart and also a line connecting the model and a movie screen mounted in the wall, where movies appropriate to the discussion will be shown. For example, in connection with ground wind loads, movies will be shown of studies being conducted by the Aeroelasticity Branch (19-ft tunnel) of the response of a 7-percent scale model of the Saturn C-1 on the launch pad. Where movies of actual studies are not available, a movie will be made illustrating the phenomena with a hand-held model.

At the conclusion of this 12-minute presentation, the speaker will mention the importance of a knowledge of the structural properties of launch vehicles and spacecraft to predict and control responses during these previously mentioned flight conditions. To satisfy this need, we are studying associated structural dynamics problems using both full-scale hardware and scaled dynamic models. Examples of which are a full-scale Thor-Agena to be tested in the near future and a 1/5-scale dynamic model of the Titan III which will be mounted on the backstop in view of the audience. Attention of the audience will be directed to the Titan and other research models on display for a few minutes.

In addition, the speaker will mention the importance of investigating the combined effect on systems resulting from simultaneous exposure to vacuum, thermal, and vibration environments. Hence, the purpose of the extreme environment chamber located in the adjacent room and also the adjacent 55-foot vacuum cylinder. The audience will then proceed into the 55-foot vacuum cylinder.

Inside the 55-foot vacuum cylinder a short movie and slides will be used to illustrate the salient features of the cylinder and its use in research. Also set up in the cylinder will be a model used for studying jet erosion, with a slide illustrating the instrumentation.

(Typed 3/20/64, bsp)

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NASA-OART FIELD INSPECTION

AIRCRAFT OPERATING PROBLEMS

Tomorrow's commercial transports will still have all the old operating problems plus the new ones arising from supersonic flight. One of these is noise and the sonic boom. This problem has left the laboratory and is being studied in the field with the help of the citizens of Oklahoma City. As aircraft are designed for higher cruising speeds, the approach and landing speeds also increase. If the solution is to lie in a direction away from more and more acres of concrete, perhaps some capital should be made of the accumulation of years of boundary layer control research. This approach has progressed to the flight test stage of large aircraft. Ames is using the C-130 cargo transport and Langley the Boeing jet transport prototype.

A more general problem is the impact of future supersonic transports on air traffic control. The flights of trans-Atlantic supersonic transports approaching a major United States terminal are being simulated by computer-controlled flight operations at Langley with telephone line tie-in with the FAA NAFEC facility at Atlantic City where the air traffic inputs are made and the air traffic problems are studied. In this dual program, Langley provides the flight performance characteristics of typical supersonic transport configurations, with and without variable-sweep wings, for example, with the aim of determining undesirable operating characteristics and directing further research to obtain satisfactory performance under all operating conditions.

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NASA-OART FIELD INSPECTION

AEROSPACE SCIENCE AND ENGINEERING

After lunch, the entire group will be taken by bus to the Exhibit Area in the Hangar. The buses will stop at the Lunar Landing and Landing Loads Track Research Facilities. The Exhibit Area in the Hangar will include the following displays:

I. Project FIRE Static Display

   A. Full-Scale Prototype Hardware With Suitable Labels and Explanation Charts
   B. Movies will be available for history, operations, launching, and reentry
   C. Table Models of Atlas Booster and Other Models of Payload and Velocity Package Are Available

II. Scout Display

   A. International Programs
   B. San Marco
   C. Micrometeorite
   D. Reentry
   E. Air Density
   F. Goddard Payloads
   G. DOD and AEC Payloads

III. Instrument Research Division Display

   A. Universal Control Display Synthesizer
   B. Miniguide System
      1. Attitude control for spinning vehicle
      2. Static display flight hardware
   C. Fluid Logic Display
   D. Project Scanner
   E. Three-Axis Magnetic Reaction Wheel Unloader
   F. Microelectronics
   G. Advanced Communication Techniques and Components
   H. Strain-Gage W.T. Balance Display
      1. X-15 model
      2. Miniature balances
      3. Water-cooled balances
   I. Vacuum Display With 10^{-13} to 10^{-14} Torr Capability
      1. Gages under development
      2. Miniature inductance gages
      3. Scanivalve system equipment
   J. Schlieren Showing Interferometer Using Laser (A gas flow visualization indication)

IV. Space Vehicle Branch

A. Solar Orientation Control System
B. Station Keeping Method for Low-Density Satellites
C. Planet Seeker for Spacecraft
D. Gravity-Gradient-Stabilized Lenticular Communications Satellite
E. Solar Energy Collectors
F. Spacecraft Aerodynamics in Free Molecular Flow
G. Atmospheric Density Measurements at Satellite Altitudes
H. Plastic Memory Effect
I. Radiation Resistant Plastics for Spacecraft
J. Fixed Temperature Control Coatings for Spacecraft
K. Automatic Temperature Control Coatings for Spacecraft

V. Ames Research Center - Bio-Sciences Exhibit

VI. Lewis Research Center - Propulsion Exhibit

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NASA-OART FIELD INSPECTION

STRUCTURES AND MATERIALS

The presentation at this stop will be on four subjects: thermal protection, supersonic transport fatigue, manned lunar landing, and manned cabin structures.

I. Thermal Protection

A. Very short demonstration of arc jet

B. Chart showing principle arc-jet facilities including 10-megawatt arc jet

C. Chart on entry and reentry thermal protection

D. Samples of ablation tested in arc jets

E. The talk on this subject will indicate how ablation gives thermal protection and the change in the requirements for heat shields and ablative materials as we go from earth reentry to planetary entry.

II. Supersonic Transport Fatigue

A. Chart showing the effect of Mach number on the fatigue testing problem

B. Talk will indicate how we have been able to do fatigue tests for short periods on subsonic aircraft and get the needed answer, but with the higher temperatures of SST we must make tests that last the lifetime of an airplane unless we can validate new techniques.

III. Manned Lunar Landing

A. Chart showing conditions under which vehicle will turn over (stable and unstable range)

B. Demonstration of dynamic model of lunar vehicle landing in simulated moon dust

C. Talk will explain the demonstration, how models can be used to predict landing behavior and the importance of a stable landing.

IV. Manned Cabin Structures

A. The talk on this subject will summarize the various functions that the wall of a manned space cabin such as might be on a space laboratory is required to accomplish. There will be some discussion of two of these functions, radiation shielding and meteoroid protection. The difference in the problems presented by these hazards in short term and long term missions both orbital and in free space will be indicated. The bumper concept for meteoroids will be introduced and its effectiveness demonstrated.

B. Charts on cabin wall functions, radiation protection, and meteoroid hazards will be shown.

C. A schematic chart of the exploding foil meteoroid gun will be used to describe it and there will be a live demonstration showing that a single sheet of aluminum is penetrated, but two thin sheets of the same total thickness but separated by a small gap will stop the meteoroid.

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NASA-OART FIELD INSPECTION

HYPERSONIC STRUCTURES RESEARCH FACILITIES

The presentation at the hypersonic structures research facilities will include the following discussion:

I. Hypersonic Temperature Problem

A. The talk will introduce a typical air-breathing hypersonic vehicle. The temperatures that will prevail over the various critical areas will be indicated and the problems of using materials to withstand these temperatures will be pointed out.

B. Colored motion pictures taken of a model under test in the 7-inch pilot tunnel of the 8-foot HTST will be shown to indicate the areas of high temperature.

C. A sketch chart will show the temperatures on the important areas of the vehicle.

II. Insulating Hypersonic Vehicle Structures

A. The need to have structures that can withstand temperatures of hypersonic flight and at the same time provide insulation to keep cryogenic fuels in their cold liquid state will be explained. Two schemes for accomplishing this dual function will be described. One of these concepts uses carbon-dioxide frost to keep the fuel cool and the other concept uses an all metal structure.

B. Two charts and two models will be used.

C. The actual working of the two concepts will be shown by dynamic demonstrations.

III. Hypersonic Structures Facilities

A. The talk will point out the need for hypersonic structures facilities as indicated in the previous talks. The experience of the 9- by 6-foot thermal tunnel will be cited as an example of a successful high-temperature tunnel and this tunnel will be described. The partially completed 8-foot high-temperature structures tunnel will then be described and shown.

B. Model of 9- by 6-foot thermal tunnel

C. Models of 8-foot HTST

D. Inspection of partially completed tunnel

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NASA-OART FIELD INSPECTION

HYPERSONICS AND REENTRY

An outline of the presentation for hypersonics and reentry is as follows:

I. Facilities

A. 31-Inch Continuous-Flow Hypersonic Tunnel

The stop will be held at this facility, which will be described and correlated with a chart showing the performance of other new LRC hypersonic facilities.

B. Reentry Corridors

Typical corridors will be shown in terms of altitude and Mach number. The problems of simulating the corresponding flight conditions in hypersonic facilities will be discussed.

C. Problem Areas

1. Fluid mechanics.- The wide difference in lift between low and high altitude at Mach number 24 caused by air viscosity will be shown as a typical example. Such problems can be studied in "cold" facilities.

2. Air chemistry.- Altitude and velocity regimes where dissociation and ionization occur will be discussed. Study of these air chemistry effects on aerodynamics and heat transfer requires "hot" facilities.

D. Facility Capabilities

1. Simulated altitude and Mach number of three LRC "cold" facilities are shown on an overlay to the chart showing the reentry corridors; these facilities are 31-inch continuous flow, hypersonic nitrogen tunnel, and 22-inch helium tunnel. Limitations of helium testing will be pointed out.

2. Another overlay will show three LRC "hot" facilities: Four-Foot Hypersonic Arc Tunnel, Hotshot Tunnel, and Expansion Tube (design and construction phase).

E. Movie of HL-10 Test in 1-Foot Hypersonic Arc Tunnel

At Mach number 12 and stagnation temperature of about 6,500° F, this movie will illustrate the kind of test that can be

conducted in an arc tunnel and will show areas of maximum heating on the model.

II. Entry Vehicles of L/D about 1

A. Characteristics of Vehicle

Reasons why the $L/D \approx 1$ vehicle is attractive will be discussed briefly. Weight is only slightly greater than nonlifting, ballistic type. Ablative primary thermal-protection, relatively free from temperature restraints, is feasible. Conventional landing without auxiliary aids is possible. $L/D \approx 1$ provides sufficient range for daily return to continental U. S. from near-earth orbits.

B. Problem Areas

The areas of research and development in the vehicle study will be briefly summarized. Photographs and models used in various tests will be displayed.

III. High L/D Hypersonic Vehicles

A. Need for High L/D

The various factors affecting range will be reviewed. The importance of L/D, and its influence on payload, air-breathing propulsion requirements, etc., will be explained. The types of aircraft in this class will be outlined.

B. Research Investigations

Studies of layouts of possible ways of integrating airframes and propulsion systems will be discussed. Wind-tunnel investigation of configurations at Mach number 6.8 in air and 20 in helium will be described. Effects on L/D of such considerations as leading-edge bluntness, provision for satisfactory stability and control, and incorporation of air inlets will be shown. Representative models and photographs will be displayed.

(Typed 3/20/64, bsp)

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NASA-OART FIELD INSPECTION

MAGNETOPLASMADYNAMICS

The theme of the Magnetoplasmadynamics Branch presentation will be on laboratory plasma research and results and will be in two parts:

I. Laboratory Astrophysics or Studies of the Sun in the Laboratory

II. Progress in Plasma-Acceleration Research

The presentation will be in Room 117 of Building 1247-D, where the magnetic-compression experiment is located. The audience will walk by the 1-megajoule capacitor bank on their way in and will be seated in the adjacent experiment room in front of the 5- by 16-foot collector plate and discharge experiment. The presentation is outlined below:

I. Laboratory Astrophysics

A. Matter in the plasma state under extreme conditions of pressure and temperature: radiation, behavior

B. Laboratory astrophysics: sun in the laboratory, studies complementing measurements by space probes and by astronauts

C. Way in which plasma is created, compressed, and confined. Plasma parameters and confinement times which can be achieved.

D. Capacitor bank, appearance, parameters

E. Demonstration of preheater; brief interpretation

F. Single out as one application the study of the solar corona. Show color slide of the corona. Temperature puzzle; solar wind; hydromagnetic processes.

II. Progress in Plasma Acceleration Research

Illustration would be made of problems and results for two basically different types of plasma accelerators.

A. Linear, crossed-field, d-c plasma accelerators

Simplest of concepts, but difficult to achieve at every detailed step of the way.

1. Problems studied and results:

   (a) Creation of plasma

   (b) Materials and engineering problems of accelerator itself

   (c) Plasma phenomena in the electromagnetic acceleration process and results

   (d) Current research (illustrated with movies of tests) and description of large accelerator now under procurement

B. Hall-current plasma accelerators

Principal difference from linear arrangement is that this type is coaxial and directions of the electric and magnetic fields for driving the plasma are arranged in different ways. Possible advantages are:

Magnetic fields can be arranged to confine the plasma away from the walls and to guide the plasma (magnetic nozzle)

The driving Hall current, which is circular, can be larger than the applied current, thus minimizing electrode problems

Can operate over a wide density range for various application

1. Types of Hall-current accelerators

   (a) Axially applied electric field description of device

   (b) Radially applied electric field

   Shaped electric and magnetic fields, with directions such that plasma acceleration is optimized, while the plasma is magnetically kept away from the walls and guided out of the nozzle.

   (1) Detailed description of experimental device

   (2) Movies of experiments showing variation in flow and thrust with electrical parameters

   (c) Present state of research and experiments with Hall-current accelerators - specific impulse, thrust level and over-all efficiency achieved and expected from such devices.

(Typed 3/23/64, bsp)

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NASA-OART FIELD INSPECTION

SPACE ENVIRONMENT

For man to exist in space for prolonged periods of time, it is essential that knowledge of space environment be greatly expanded. This presentation will cover examples of research aimed at broadening knowledge of space environment, will examine what is required to support man in space and, finally, will consider what man can accomplish in space.

With regard to space environment, the discussion will be limited to use of 12-foot-diameter balloon satellites to measure air density; the use of specially equipped ground facilities to simulate and study the temperature effects caused by exposure of spacecraft to the direct rays of the sun; the continuing study of the source and nature of radiation in the Van Allen belts, solar radiation, and galactic and cosmic radiation; and results obtained by the micrometeoroid satellite program.

Support of life in space in the confines of a space station poses a host of technological problems somewhat akin to those of submissible ocean vessels, but with some limitations on weight. Some hardware developed to sustain life in space will be displayed and described. One example concurs to practical design of air locks with considerations of astronaut mobility. The approach to life support system integration will be shown.

(Typed 3/20/64, bsp)

OPTIONAL FORM NO. 10
30.0-104

UNITED STATES GOVERNMENT

Memorandum

Room 202, B-1212
Stop 710

Langley Research Center

(5)

TO : Director

DATE: March 27, 1964

FROM : Research Assistant for Manned Spacecraft Projects

SUBJECT: Work schedule for NASA-OART 1964 Inspection at LRC

March 2	Reviewed preliminary layouts - "firmed-up" requirements.
March 15	Reviewed all exhibit layouts and arrangements.
March 25	(a) Contract awards for: (1) Renovating exhibit supports, etc. (2) Bleacher erection, etc. (3) Accessories, photos, blackout material (b) In-house - Reviewed development of presentations and suitability and delivery schedules of accessories
April 15	All LRC panels and exhibit supports in locations for all stops.
April 20	All preliminary layouts and temporary positioning of models, illustrations, charts and descriptive, designations approved and in tentative positions by Inspection Staff. (Possible first-cut review by Langley Director.)
May 1	Exhibits complete, all essential accessories and services in approved positions and functioning facility and grounds housekeeping and clean-up.
May 4	LRC - Director's dress rehearsal.
May 11	Rehearsals for timing, acoustics, lighting, detail adjustments.
May 18	Official V.I.P. visitations.
May 22	Prepare for Open House, 4:30 p.m. to 1:00 a.m.
May 23	Arrange all details adjoining B-1244, Hangar doors to suit weather and Open House visitors (20,000 persons expected if fair weather prevails). Adjust details at Activities Building (1222) to suit Open House. All work to be completed by 10:00 a.m.
May 25	Remove or relocate those exhibit parts in Building 1244.

Axel T. Mattson

cc: See attached distribution list

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